We claim:

1. An optoelectronic device on a substrate comprising:

a waveguide comprising:

a slab of monocrystalline silicon on the substrate,

a layer of dielectric material disposed on the slab of monocrystalline silicon

and

a strip of polysilicon disposed on the layer of dielectric material,

a plurality of doped regions in the slab of monocrystalline silicon, where at least first and second doped regions are formed in the slab of monocrystalline silicon,

and

a plurality of electrical contacts, where at least first and second electrical contacts are formed in respective first and second doped regions of the plurality of doped regions in the slab of monocrystalline silicon.

2. The optoelectronic device of claim 1, wherein the substrate is selected out of a group comprised of:

a layer of silicon dioxide disposed on a layer of monocrystalline silicon,

a layer of sapphire, and

an air filled cavity.

3. The optoelectronic device of claim 1, wherein the layer of dielectric material is comprised of silicon dioxide.

4. The optoelectronic device of claim 1, wherein the first and second doped regions of the plurality of doped regions are oppositely charged.

5. The optoelectronic device of claim 4, wherein the optoelectronic device comprises an active waveguide with a PIN diode.

6. The optoelectronic device of claim 1, and further comprising a third doped region in the slab of monocrystalline silicon.

7. The optoelectronic device of claim 6, wherein the second doped region is oppositely charged to the first doped region.

8. The optoelectronic device of claim 7, wherein the optoelectronic device comprises an active waveguide with a $P/N^-/N$ diode.

9. The optoelectronic device of claim 1, and further comprising a third doped region in the slab of monocrystalline silicon, where the third doped region is oppositely charged to the first and second doped regions.

10. The optoelectronic device of claim 9, wherein the optoelectronic device comprises an active waveguide with a drain induced barrier lowering (DIBL) diode.

11. The optoelectronic device of claim 1, and further comprising the longitudinal propagation of an optical signal through substantially the central section of the waveguide,
where the central section of the waveguide guides the substantial majority of the power of the optical signal propagating down the waveguide
and
where each of the plurality of electrical contacts are formed not in proximity to the central section of the waveguide.

12. The optoelectronic device of claim 1, wherein each of the plurality of electrical contacts is comprised of an ohmic contact.

13. The optoelectronic device of claim 1, and further comprising at least one conductive plug coupling one of the plurality of electrical contacts to at least one of a plurality of metal layers of an integrated circuit.

14. The optoelectronic device of claim 1, and further comprising at least one local interconnection for coupling an electrical contact on the slab of monocrystalline silicon with an electrical contact on a device formed on the substrate.

15. The optoelectronic device of claim 1, wherein at least one of the plurality of electrical contacts is coupled to a device formed on the substrate and where the device is selected from the group comprising: a CMOS transistor, a BiCMOS transistor, a bipolar junction transistor (BJT), a

junction FET (JFET) transistor, a diode, a resistor, a capacitor and an inductor.

16. The optoelectronic device of claim 1, and further comprising the coupling of an electrical signal to at least one of the plurality of electrical contacts,

where the electrical signal can change the free carrier density within a region in the slab of monocrystalline silicon.

17. The optoelectronic device of claim 16, wherein changing the free carrier density in a region can change the refractive index within the region in the slab of monocrystalline silicon.

18. The optoelectronic device of claim 17, wherein changing the refractive index within a region in the slab of monocrystalline silicon can cause a phase shift in an optical signal propagating through the region in the slab of monocrystalline silicon.

19. The optoelectronic device of claim 16, wherein changing the free carrier density within a region in the slab of monocrystalline silicon can change the attenuation of an optical signal propagating through the slab of monocrystalline silicon.

20. The optoelectronic device of claim 16, wherein the region of change in free carrier density comprises an active region in the slab of monocrystalline silicon.

21. The optoelectronic device of claim 1, wherein at least one doped region in the slab of monocrystalline silicon is formed by an implantation of dopant into the slab of monocrystalline silicon,
where the strip of polysilicon substantially blocks the implanting of dopant into a region of monocrystalline silicon substantially underneath the polysilicon strip.

22. The optoelectronic device of claim 1, and further comprising the use of an implantation beam for depositing dopant into at least one of the plurality of doped regions, where the energy level of the implantation beam is controlled to deposit a dopant into a selected layer of the waveguide.

23. The optoelectronic device of claim 22, wherein at least one doped region in the slab of monocrystalline silicon is formed by the implantation of dopant into the slab of monocrystalline silicon.

24. An optoelectronic device on a substrate comprising:
a waveguide comprising:

a layer of monocrystalline silicon on the substrate,
a layer of dielectric material disposed on the layer of monocrystalline silicon,
a slab of monocrystalline silicon disposed on the layer of dielectric,
a layer of dielectric material disposed on the slab of monocrystalline silicon
and

a strip of polysilicon disposed on the layer of dielectric material,

a plurality of doped regions in the slab of monocrystalline silicon, where at least first and second doped regions are formed in the slab of monocrystalline silicon,
and
a plurality of electrical contacts, where at least first and second electrical contacts are formed in respective first and second doped regions of the plurality of doped regions in the slab of monocrystalline silicon.

25. The optoelectronic device of claim 24, wherein the layer of dielectric material is comprised of silicon dioxide.

26. The optoelectronic device of claim 24, wherein the first and second doped regions of the plurality of doped regions are oppositely charged.

27. The optoelectronic device of claim 26, wherein the optoelectronic device comprises an active waveguide with a PIN diode.

28. The optoelectronic device of claim 24, and further comprising a third doped region in the slab of monocrystalline silicon.

29. The optoelectronic device of claim 28, wherein the second doped region is oppositely charged to the first doped region.

30. The optoelectronic device of claim 29, wherein the optoelectronic device comprises an active waveguide with a $P/N^-/N$ diode.

31. The optoelectronic device of claim 24, and further comprising a third doped region in the slab of monocrystalline silicon, where the third doped region is oppositely charged to the first and second doped regions.

32. The optoelectronic device of claim 31, wherein the optoelectronic device comprises an active waveguide with a drain induced barrier lowering (DIBL) diode.

33. The optoelectronic device of claim 24, and further comprising the longitudinal propagation of an optical signal through substantially the central section of the waveguide,
where the central section of the waveguide guides the substantial majority of the power of the optical signal propagating down the waveguide
and
where each of the plurality of electrical contacts are formed not in proximity to the central section of the waveguide.

34. The optoelectronic device of claim 24, wherein each of the plurality of electrical contacts is comprised of an ohmic contact.

35. The optoelectronic device of claim 24, and further comprising at least one conductive plug coupling one of the plurality of electrical contacts to at least one of a plurality of metal layers of an integrated circuit.

36. The optoelectronic device of claim 24, and further comprising at least one local interconnection for coupling an electrical contact on the slab of monocrystalline silicon with an electrical contact on a device formed on the substrate.

37. The optoelectronic device of claim 24, wherein at least one of the plurality of electrical contacts is coupled to a device formed on the substrate and where the device is selected from the group comprising: a CMOS transistor, a BiCMOS transistor, a bipolar junction transistor (BJT), a junction FET (JFET) transistor, a diode, a resistor, a capacitor and an inductor.

38. The optoelectronic device of claim 24, and further comprising the coupling of an electrical signal to at least one of the plurality of electrical contacts,
where the electrical signal can change the free carrier density within a region in the slab of monocrystalline silicon.

39. The optoelectronic device of claim 38, wherein changing the free carrier density in a region can change the refractive index within the region in the slab of monocrystalline silicon.

40. The optoelectronic device of claim 39, wherein changing the refractive index within a region in the slab of monocrystalline silicon can

cause a phase shift in an optical signal propagating through the region in the slab of monocrystalline silicon.

41. The optoelectronic device of claim 38, wherein changing the free carrier density within a region in the slab of monocrystalline silicon can change the attenuation of an optical signal propagating through the slab of monocrystalline silicon.

42. The optoelectronic device of claim 38, wherein the region of change in free carrier density comprises an active region in the slab of monocrystalline silicon.

43. The optoelectronic device of claim 24, wherein at least one doped region in the slab of monocrystalline silicon is formed by an implantation of dopant into the slab of monocrystalline silicon,
where the strip of polysilicon substantially blocks the implanting of dopant into a region of monocrystalline silicon substantially underneath the polysilicon strip.

44. The optoelectronic device of claim 24, wherein at least one doped region in the slab of monocrystalline silicon is formed by a high energy beam implantation of dopant into the slab of monocrystalline silicon.

45. The optoelectronic device of claim 24, and further comprising the use of an implantation beam for depositing dopant into at least one of the

plurality of doped regions, where the energy level of the implantation beam is controlled to deposit a dopant into a selected layer of the waveguide.

46. The optoelectronic device of claim 45, wherein at least one doped region in the slab of monocrystalline silicon is formed by the implantation of dopant into the slab of monocrystalline silicon.

47. An optoelectronic device on a substrate comprising:

a waveguide comprising:

a slab of monocrystalline silicon disposed on the substrate,
a layer of dielectric material on the slab of monocrystalline silicon, and
a strip of monocrystalline silicon disposed on the layer of dielectric material,

a plurality of doped regions in the slab of monocrystalline silicon, where at least first and second doped regions are formed in the slab of monocrystalline silicon,
and
a plurality of electrical contacts, where at least first and second electrical contacts are formed in the respective first and second doped regions in the slab of monocrystalline silicon.

48. The optoelectronic device of claim 47, wherein the layer of dielectric material is comprised of silicon dioxide.

49. The optoelectronic device of claim 47, wherein the first and second doped regions of the plurality of doped regions are oppositely charged.

50. The optoelectronic device of claim 49, wherein the optoelectronic device comprises an active waveguide with a PIN diode.

51. The optoelectronic device of claim 47, and further comprising a third doped region in the slab of monocrystalline silicon.

52. The optoelectronic device of claim 51, wherein the second doped region is oppositely charged to the first doped region.

53. The optoelectronic device of claim 52, wherein the optoelectronic device comprises an active waveguide with a P/N^-/N diode.

54. The optoelectronic device of claim 47, and further comprising a third doped region in the slab of monocrystalline silicon, where the third doped region is oppositely charged to the first and second doped regions.

55. The optoelectronic device of claim 54, wherein the optoelectronic device comprises an active waveguide with a drain induced barrier lowering (DIBL) diode.

56. The optoelectronic device of claim 47, and further comprising the longitudinal propagation of an optical signal through substantially the central section of the waveguide,
where the central section of the waveguide guides the substantial majority of the power of the optical signal propagating down the waveguide
and
where each of the plurality of electrical contacts are formed not in proximity to the central section of the waveguide.

57. The optoelectronic device of claim 47, wherein each of the plurality of electrical contacts is comprised of an ohmic contact.

58. The optoelectronic device of claim 47, and further comprising at least one conductive plug coupling one of the plurality of electrical contacts to at least one of a plurality of metal layers of an integrated circuit.

59. The optoelectronic device of claim 47, and further comprising at least one local interconnection for coupling an electrical contact on the slab of monocrystalline silicon with an electrical contact on a device formed on the substrate.

60. The optoelectronic device of claim 47, wherein at least one of the plurality of electrical contacts is coupled to a device formed on the substrate and where the device is selected from the group comprising: a CMOS transistor, a BiCMOS transistor, a bipolar junction transistor (BJT), a

junction FET (JFET) transistor, a diode, a resistor, a capacitor and an inductor.

61. The optoelectronic device of claim 47, and further comprising the coupling of an electrical signal to at least one of the plurality of electrical contacts,
where the electrical signal can change the free carrier density within a region in the slab of monocrystalline silicon.

62. The optoelectronic device of claim 61, wherein changing the free carrier density in a region can change the refractive index within the region in the slab of monocrystalline silicon.

63. The optoelectronic device of claim 62, wherein changing the refractive index within a region in the slab of monocrystalline silicon can cause a phase shift in an optical signal propagating through the region in the slab of monocrystalline silicon.

64. The optoelectronic device of claim 61, wherein changing the free carrier density within a region in the slab of monocrystalline silicon can change the attenuation of an optical signal propagating through the slab of monocrystalline silicon.

65. The optoelectronic device of claim 61, wherein the region of change in free carrier density comprises an active region in the slab of monocrystalline silicon.

66. The optoelectronic device of claim 47, wherein at least one doped region in the slab of monocrystalline silicon is formed by an implantation of dopant into the slab of monocrystalline silicon,

where the strip of polysilicon substantially blocks the implanting of dopant into a region of monocrystalline silicon substantially underneath the polysilicon strip.

67. The optoelectronic device of claim 47, wherein at least one doped region in the slab of monocrystalline silicon is formed by a high energy beam implantation of dopant into the slab of monocrystalline silicon.

68. The optoelectronic device of claim 47, and further comprising the use of an implantation beam for depositing dopant into at least one of the plurality of doped regions, where the energy level of the implantation beam is controlled to deposit a dopant into a selected layer of the waveguide.

69. The optoelectronic device of claim 67, wherein at least one doped region in the slab of monocrystalline silicon is formed by the implantation of dopant into the slab of monocrystalline silicon.

70. An optoelectronic device on a substrate comprising:

a rib waveguide comprising:

a slab of monocrystalline silicon on the substrate,

a silicon rib formed on the slab of monocrystalline silicon,

a first region of silicon formed on the slab of monocrystalline silicon along a first side of the rib, separated from the rib by a first region of dielectric,
a second region of silicon formed on the slab of monocrystalline silicon along a second side of the rib, separated from the rib by a second region of dielectric,

a plurality of doped regions in the slab of monocrystalline silicon, where a first and second doped region of the plurality of doped regions each respectively include the first and second regions of silicon,
and
a plurality of electrical contacts, where at least first and second electrical contacts are formed in respective first and second regions of silicon.

71. The optoelectronic device of claim 70, wherein the substrate is selected out of a group comprised of:
a layer of silicon dioxide disposed on a layer of monocrystalline silicon,
a layer of sapphire, and
an air filled cavity.

72. The optoelectronic device of claim 70, wherein the layer of dielectric material is comprised of silicon dioxide.

73. The optoelectronic device of claim 70, wherein first and second doped regions of the plurality of doped regions are oppositely charged.

74. The optoelectronic device of claim 73, wherein the optoelectronic device comprises an active waveguide with a PIN diode.

75. The optoelectronic device of claim 70, and further comprising a third doped region in the slab of monocrystalline silicon.

76. The optoelectronic device of claim 75, wherein the second doped region is oppositely charged to the first doped region.

77. The optoelectronic device of claim 76, wherein the optoelectronic device comprises an active waveguide with a $P/N^{-}/N$ diode.

78. The optoelectronic device of claim 70, and further comprising a third doped region in the slab of monocrystalline silicon, where the third doped region is oppositely charged to the first and second doped regions.

79. The optoelectronic device of claim 78, wherein the optoelectronic device comprises an active waveguide with a drain induced barrier lowering (DIBL) diode.

80. The optoelectronic device of claim 70, and further comprising the longitudinal propagation of an optical signal through substantially the central section of the waveguide,
where the central section of the waveguide guides the substantial majority of the power of the optical signal propagating down the waveguide
and

where each of the plurality of electrical contacts are formed not in proximity to the central section of the waveguide.

81. The optoelectronic device of claim 70, wherein each of the plurality of electrical contacts is comprised of an ohmic contact.

82. The optoelectronic device of claim 70, and further comprising at least one conductive plug coupling one of the plurality of electrical contacts to at least one of a plurality of metal layers of an integrated circuit.

83. The optoelectronic device of claim 70, and further comprising at least one local interconnection for coupling an electrical contact on the slab of monocrystalline silicon with an electrical contact on a device formed on the substrate.

84. The optoelectronic device of claim 70, wherein at least one of the plurality of electrical contacts is coupled to a device formed on the substrate and where the device is selected from the group comprising: a CMOS transistor, a BiCMOS transistor, a bipolar junction transistor (BJT), a junction FET (JFET) transistor, a diode, a resistor, a capacitor and an inductor.

85. The optoelectronic device of claim 70, and further comprising the coupling of an electrical signal to at least one of the plurality of electrical contacts,

where the electrical signal can change the free carrier density within a region in the slab of monocrystalline silicon.

86. The optoelectronic device of claim 85, wherein changing the free carrier density in a region can change the refractive index within the region in the slab of monocrystalline silicon.

87. The optoelectronic device of claim 86, wherein changing the refractive index within a region in the slab of monocrystalline silicon can cause a phase shift in an optical signal propagating through the region in the slab of monocrystalline silicon.

88. The optoelectronic device of claim 85, wherein changing the free carrier density within a region in the slab of monocrystalline silicon can change the attenuation of an optical signal propagating through the slab of monocrystalline silicon.

89. The optoelectronic device of claim 85, wherein the region of change in free carrier density comprises an active region in the slab of monocrystalline silicon.

90. The optoelectronic device of claim 70, wherein at least one doped region in the slab of monocrystalline silicon is formed by an implantation of dopant into the slab of monocrystalline silicon,

where the strip of polysilicon substantially blocks the implanting of dopant into a region of monocrystalline silicon substantially underneath the polysilicon strip.

91. The optoelectronic device of claim 70, and further comprising the use of an implantation beam for depositing dopant into at least one of the plurality of doped regions, where the energy level of the implantation beam is controlled to deposit a dopant into a selected layer of the waveguide.

92. The optoelectronic device of claim 91, wherein at least one doped region in the slab of monocrystalline silicon is formed by the implantation of dopant into the slab of monocrystalline silicon.

93. An optoelectronic device on a substrate comprising:
a waveguide comprising:

a slab of monocrystalline silicon on the substrate,

a layer of dielectric material disposed on the slab of monocrystalline silicon

and

a strip of polysilicon disposed on the layer of dielectric material,

a plurality of doped regions in the slab of monocrystalline silicon, where at least first, second and third doped regions are formed in the slab of monocrystalline silicon, where the second and third doped regions are oppositely charged to the first doped region in the slab of monocrystalline silicon,

a doped region in the strip of polysilicon, where the doped region in the strip of polysilicon is oppositely charged to the first doped region in the slab of monocrystalline silicon,

a plurality of electrical contacts, where at least first and second electrical contacts are formed in respective second and third doped regions of the plurality of doped regions in the slab of monocrystalline silicon,
and
where at least a third electrical contact is formed in the doped region in the strip of polysilicon.

94. The optoelectronic device of claim 93, wherein the substrate is selected out of a group comprised of:
a layer of silicon dioxide disposed on a layer of monocrystalline silicon,
a layer of sapphire,
an air filled cavity
and
a first layer comprised of monocrystalline silicon,
a second layer comprised of silicon dioxide disposed on the first layer,
a third layer comprised of monocrystalline silicon disposed on the second layer and
a fourth layer comprised of silicon dioxide disposed on the third layer.

95. The optoelectronic device of claim 93, wherein the layer of dielectric material is comprised of silicon dioxide.

96. The optoelectronic device of claim 93, wherein the optoelectronic device comprises an active waveguide with a transistor.

97. The optoelectronic device of claim 93, and further comprising the longitudinal propagation of an optical signal through substantially the central section of the waveguide,
where the central section of the waveguide guides the substantial majority of the power of the optical signal propagating down the waveguide
and
where each of the plurality of electrical contacts are formed not in proximity to the central section of the waveguide.

98. The optoelectronic device of claim 93, wherein each of the plurality of electrical contacts is comprised of an ohmic contact.

99. The optoelectronic device of claim 93, and further comprising at least one conductive plug coupling one of the plurality of electrical contacts to at least one of a plurality of metal layers of an integrated circuit.

100. The optoelectronic device of claim 93, and further comprising at least one local interconnection for coupling an electrical contact on the slab of monocrystalline silicon with an electrical contact on a device formed on the substrate.

101. The optoelectronic device of claim 93, wherein at least one of the plurality of electrical contacts is coupled to a device formed on the substrate and where the device is selected from the group comprising: a CMOS transistor, a BiCMOS transistor, a bipolar junction transistor (BJT), a junction FET (JFET) transistor, a diode, a resistor, a capacitor and an inductor.

102. The optoelectronic device of claim 93, and further comprising the coupling of an electrical signal to at least one of the plurality of electrical contacts,
where the electrical signal can change the free carrier density within a region in the slab of monocrystalline silicon.

103. The optoelectronic device of claim 102, wherein changing the free carrier density in a region can change the refractive index within the region in the slab of monocrystalline silicon.

104. The optoelectronic device of claim 103, wherein changing the refractive index within a region in the slab of monocrystalline silicon can cause a phase shift in an optical signal propagating through the region in the slab of monocrystalline silicon.

105. The optoelectronic device of claim 102, wherein changing the free carrier density within a region in the slab of monocrystalline silicon can change the attenuation of an optical signal propagating through the slab of monocrystalline silicon.

106. The optoelectronic device of claim 102, wherein the region of change in free carrier density comprises an active region in the slab of monocrystalline silicon.

107. The optoelectronic device of claim 93, wherein at least one doped region in the slab of monocrystalline silicon is formed by an implantation of dopant into the slab of monocrystalline silicon,
where the strip of polysilicon substantially blocks the implanting of dopant into a region of monocrystalline silicon substantially underneath the polysilicon strip.

108. The optoelectronic device of claim 93, and further comprising the use of an implantation beam for depositing dopant into at least one of the plurality of doped regions, where the energy level of the implantation beam is controlled to deposit a dopant into a selected layer of the waveguide.

109. The optoelectronic device of claim 108, wherein at least one doped region in the slab of monocrystalline silicon is formed by the implantation of dopant into the slab of monocrystalline silicon.

110. An optoelectronic device on a substrate comprising:
a waveguide comprising:
a layer of monocrystalline silicon on the substrate,
a layer of dielectric material disposed on the layer of monocrystalline silicon,

a slab of monocrystalline silicon disposed on the layer of dielectric,
a layer of dielectric material disposed on the slab of monocrystalline silicon
and
a strip of polysilicon disposed on the layer of dielectric material,

a first doped region in the slab of monocrystalline silicon,
a second doped region in the layer of monocrystalline silicon,
a first plurality of electrical contacts formed in the first doped region,
and
a second plurality of electrical contacts formed in the second doped region.

111. The optoelectronic device of claim 110, wherein the substrate is selected out of a group comprised of:
a layer of silicon dioxide disposed on a layer of monocrystalline silicon,
a layer of sapphire and
an air filled cavity.

112. The optoelectronic device of claim 110, wherein the layer of dielectric material is comprised of silicon dioxide.

113. The optoelectronic device of claim 110, wherein the optoelectronic device comprises an active waveguide with a capacitor.

114. The optoelectronic device of claim 110, and further comprising the longitudinal propagation of an optical signal through substantially the central section of the waveguide,

where the central section of the waveguide guides the substantial majority of the power of the optical signal propagating down the waveguide

and

where each of the pluralities of electrical contacts are formed not in proximity to the central section of the waveguide.

115. The optoelectronic device of claim 110, wherein each of the pluralities of electrical contacts is comprised of an ohmic contact.

116. The optoelectronic device of claim 110, and further comprising at least one conductive plug for coupling one of the pluralities of electrical contacts to at least one of a plurality of metal layers of an integrated circuit.

117. The optoelectronic device of claim 110, and further comprising at least one local interconnection for coupling one of the first plurality of electrical contacts on the slab of monocrystalline silicon with an electrical contact on a device formed on the substrate.

118. The optoelectronic device of claim 110, wherein at least one of the pluralities of electrical contacts is coupled to a device formed on the substrate and where the device is selected from the group comprising: a CMOS transistor, a BiCMOS transistor, a bipolar junction transistor (BJT),

a junction FET (JFET) transistor, a diode, a resistor, a capacitor and an inductor.

119. The optoelectronic device of claim 110, and further comprising the coupling of an electrical signal to at least one of the plurality of pluralities of electrical contacts,
where the electrical signal can change the free carrier density within a region in the waveguide.

120. The optoelectronic device of claim 119, wherein changing the free carrier density in the region in the waveguide can change the refractive index within the region in the waveguide.

121. The optoelectronic device of claim 120, wherein changing the refractive index within the region in the waveguide can cause a phase shift in an optical signal propagating through the region in the waveguide.

122. The optoelectronic device of claim 119, wherein changing the free carrier density within the region in the waveguide can change the attenuation of an optical signal propagating through the region in the waveguide.

123. The optoelectronic device of claim 119, wherein the region of change in free carrier density comprises an active region in the waveguide.

124. The optoelectronic device of claim 110, and further comprising the use of an implantation beam for depositing dopant into at least one of the doped regions, where the energy level of the implantation beam is controlled to deposit a dopant into a selected layer of the waveguide.